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TECHNICAL REPORT
66-43-ME

EVALUATION OF TRUCK, FORKLIFT, BAKER 4,000-LB CAPACITY, GASOLINE-ENGINE-DRIVEN

by
Joseph R. Peters

May 1966

UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760

Mechanical Engineering Division
MHE-9

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TECHNICAL REPORT

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EVALUATION OF TRUCK, FORKLIFT

BAKER 4,000-LB CAPACITY, GASOLINE-ENGINE-DRIVEN

by

Joseph R. Peters

Materials Handling Equipment Branch

PEMA Project 40403 Series: MHE-9

May 1966

Mechanical Engineering Division
U.S. ARMY NATICK LABORATORIES
Natick, Massachusetts

FOREWORD

It is of vital importance that the Army keep abreast of the latest advances in both equipment and methods made by the materials handling industry.

The U. S. Army Materiel Command's Natick Laboratories is continuously surveying these developments for possible application toward enhancing military warehousing applications. As logistics become more complex, the need for improved machines and techniques in handling, storing, loading, and unloading the increasing volume of supplies required to maintain national preparedness becomes more evident.

This report covers an evaluation of a Baker industrial truck, model FJD-050, 4,000-lb. capacity at 24-inch load center, 180-inch lift height, "Tiger Series," gasoline engine-driven, forklift truck, solid-rubber tired. The results obtained will provide a basis for updating applicable specifications to provide the military with the most modern equipment available.

Acknowledgement is made to the Methods and Modernization Branch, Operations Division, U.S. Army Supply and Maintenance Command's Packaging, Storage, and Transportability Center, Tobyhanna Army Depot, Tobyhanna, Pennsylvania who provided the excellent user evaluation data for this study.

JAMES H. FLANAGAN
Acting Chief
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Scientific Director

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Colonel, QMC
Commanding

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

Preproduction engineering for materials handling equipment requires that the latest commercial materials handling equipment be evaluated to make certain that military specifications are continuously updated to reflect advances in both industry and new Army requirements.

To ascertain the Army procures the most modern, efficient, and reliable equipment at the lowest cost, these laboratories purchased a Model FJD-050, 4,000-lb capacity at 24-inch load center, 180-inch lift height, "Tiger Series," gasoline-engine-driven, forklift truck from the Baker Industrial Trucks, a Division of Otis Elevator Company, Cleveland, Ohio.

The manufacturer claimed the Baker "Tiger Series" vehicle possessed lifting and travelling speeds that are 25 percent faster than comparable standard trucks of other manufacture, and when tested against competitive equipment, their vehicle would move an average of 15% more goods during a series of eight-hour shifts.

An evaluation was performed to determine if specifications could be updated to increase requirements for travelling, lifting and lowering speeds without decreasing performance in other areas.

From this evaluation it has been determined that increased speeds will enhance the Army's warehousing operations and the specification should be changed to reflect these increased speeds.

EVALUATION OF TRUCK, FORKLIFT, BAKER 4,000-LB CAPACITY, GASOLINE ENGINE-DRIVEN

Introduction

The purpose of this evaluation is to determine if increasing the lifting speed from 40 fpm to 60 fpm, the lowering speed from 27 fpm to 40 fpm, and the rate of acceleration from 44 feet in not more than 6 seconds to 44 feet in not more than 5.5 seconds, will enhance military warehousing operations. If so, the applicable specification will be updated to reflect these increases.

The evaluation consisted of two phases:

Phase I - An engineering evaluation was performed on the Baker "Tiger Series" at the U.S. Army Natick Laboratories from July 1964 through January 1966. The evaluation was performed to verify manufacturers' claims prior to subjecting the vehicle to user evaluation. The physical characteristics and selected performance requirements described in Military Specification MIL-T-15445J were performed and the data recorded.

Phase II - A user evaluation was performed by the U.S. Army Supply and Maintenance Command at Tobyhanna Army Depot, Tobyhanna, Pennsylvania, from March 1965 through October 1965, to determine the capacity of the Baker "Tiger Series" to excel present standard lift trucks of its general class in diversified materials handling capabilities.

The Baker vehicle (Figure 1) was compared and evaluated with other forklift trucks which have undergone similar evaluations. An opinion poll from various operators on specified performance features was also taken and recorded.

Discussion

Phase I - These laboratories recorded the basic physical characteristics of the Baker "Tiger Series" forklift truck (Table I). Various operational characteristics pertaining to vehicle speed were also recorded (Table II).

Information on operational characteristics while carrying a 4,000-lb. load is as follows:

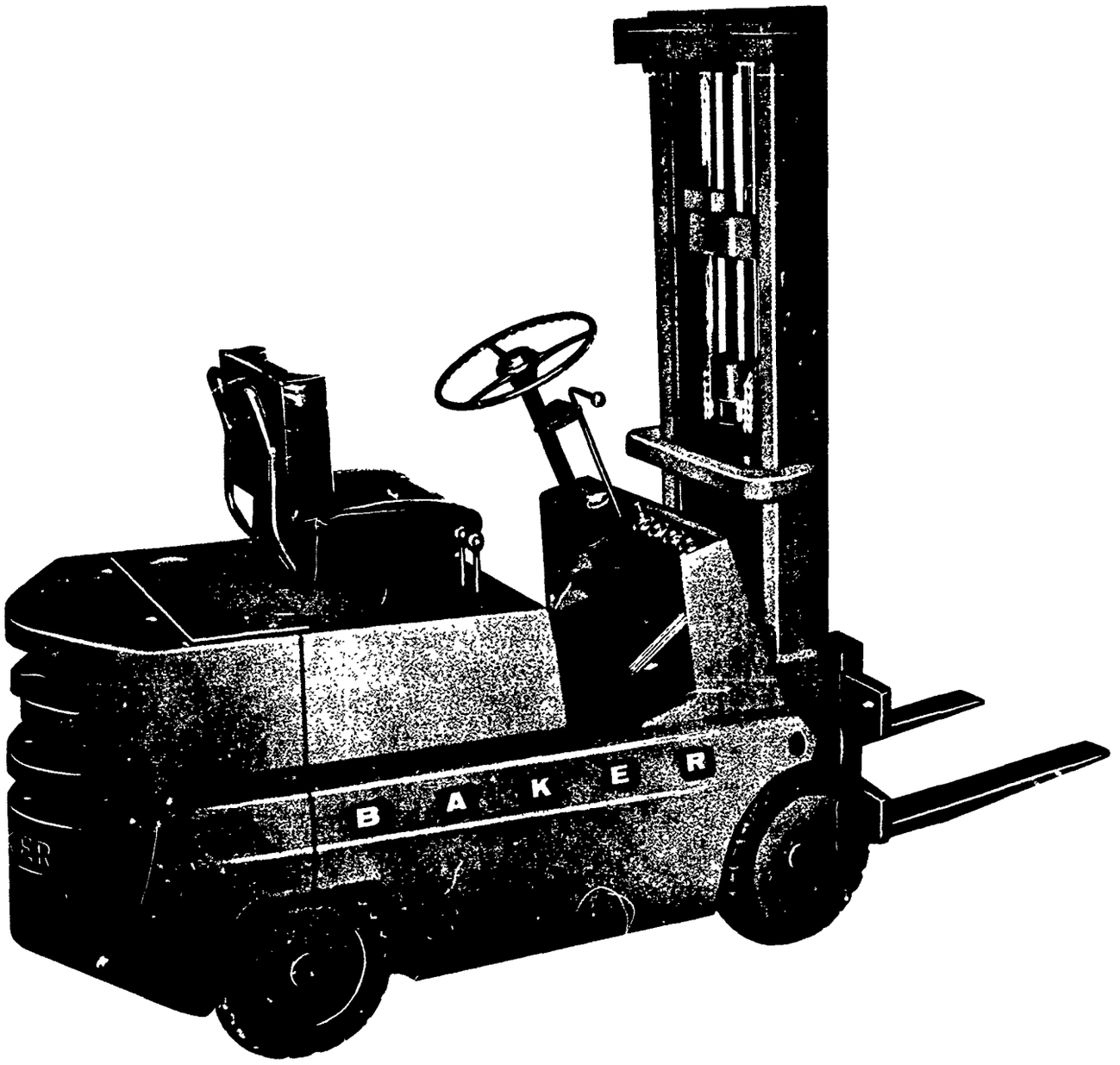

Figure 1. Baker Model FJD-050, 4,000-lb Capacity at 24-inch Load Center, 180-inch Lift Height, "Tiger Series," Gasoline-Engine-Driven, Forklift Truck

Travel Speed - 9.25 mph forward, and 8.57 mph in reverse. The specification requires a travel speed of 6 to 9 mph in both the forward and reverse directions while carrying a rated load.

Lifting Speed - 83.3 fpm. The specification requires a minimum lift speed of 40 fpm with rated load.

Lowering Speed - 60 fpm. The specification requires a minimum lowering speed of 27 fpm with rated load.

Phase I indicated that the Baker "Tiger Series" does possess greater speeds than those required in the specification, and this vehicle should be compared with standard Army forklift trucks while performing actual warehousing operations to determine if the specification should be updated to include the increased speeds.

Table I

PHYSICAL CHARACTERISTICS

Manufacturer	Baker Industrial Truck, A Division of Otis Elevator Company
Model	"Tiger Series" FJD-050
Contract No.	DA19-129-AMC-259(N)
Load Capacity at 24" L.C.	4,000-lbs
Lift Height	180 inches
Free Lift	24-1/2 inches
Collapsed Mast Height	82-3/4 inches
Overall length	123 inches
Overall width	41-1/2 inches
Type of Overhead Guard	100 lbs regular
Height to Top of Overhead Guard	80-3/4 inches
Height from seat to bottom of overhead guard	39-1/2 inches
Height from seat to ground	39-1/4 inches
Wheel Base	50 inches
Wheel Track	39-3/4 inches
Length of Overhang from Rear Axle	18-1/2 inches
Distance from front axle to face of forks	12-1/2 inches

Table I (Cont'd)

PHYSICAL CHARACTERISTICS

Lighting	Forward	-	Two 32 cp (one adjustable)
	Rear	-	Two 32 cp (one adjustable)
Tilt degrees	Forward	-	2^{o} - 15'
	Rear	-	4^{o} - 55'
Forks	Length	-	40 inches
	Width	-	4 inches
	Thickness	-	1-3/4 inches
Engine	Make	-	Continental
	Model	-	F-162
	Type	-	L-head
	No. Cylinders		4
	Displacement		162 in^3
	Brake hp at maximum governed rpm		55 at 2500
	Type ignition		12-volt battery
Capacities	Fuel tank		8 gallons
	Hydraulic tank		30 quarts
	Crankcase		4 quarts
	Transmission and differential		16 quarts
	Cooling system		11 quarts
	Oil filter		1 quart
	Number		4
Tires	Type		Cushion
	Sixe - Front		18 x 8 x 12-1/8
	Rear		16 x 5 x 10-1/2
Brakes	Service		Self-adjusting, hydraulic
	Parking		Manual

Table II

OPERATIONAL CHARACTERISTICS

Manufacturer	Baker Industrial Truck, A Division of Otis Elevator Company
Model	"Tiger Series" FJD-050
Contract No.	DA19-129-AMC-259(N)

Table II (Cont'd)

OPERATIONAL CHARACTERISTICS

No load	Travel speed - Fwd	10.4 mph
	Rev	8.37 mph
4,000-lb Load	Travel speed - Fwd	9.25 mph
	Rev	8.57 mph
Lifting speed	No load - Up	85.5 fpm
	Down	53.2 fpm
	4,000-lb Load - Up	83.3 fpm
	Down -	60.0 fpm
Acceleration	Forward	3.60 ft/sec^2
	Reverse	3.52 ft/sec^2
Tilt	Forward	4^o - 55'
		2^o - 15'

Phase II - The U.S. Army Supply and Maintenance Command's Packaging Storage and Transportability Center at Tobyhanna Army Depot, Tobyhanna, Pennsylvania, compared the Baker "Tiger Series" with five other 4,000-lb capacity standard forklift trucks. Table III shows the comparative characteristics of the Baker truck and the five standard trucks used during the evaluation. All vehicles were evaluated while performing general warehousing functions, such as receiving, shipping, rewarehousing, carloading, truck loading, and general movement of materiel from one area to another. Operator appraisal was considered an important factor in the evaluation, and was recorded on a daily basis. The daily evaluation was compiled into a single list of operator preference (Table IV).

It was found from operator appraisals which the Baker vehicle confirms that increased travel speed, acceleration, lift and lowering speeds can noticeably enhance the production capability of the forklift truck without decreasing performance in other areas.

Table III

LIFT TRUCK COMPARISON CHART

ELEMENT	Comparable Lift Trucks 1. Test Trucks; Baker FJD-050	2. Hyster S-40-B	3. Yale G-54-C	4. Baker FJA-050	5. Clark C-40-B	6. KGA-51 AT-40U
1. Length, overall	123"	120-3/8"	126"	124½"	125¼"	123"
2. Width, overall	41½"	39½"	42½"	43¼"	41½"	39¼"
3. Wheelbase	50"	51"	56-3/4"	49½"	52½"	47"
4. Height, mast collapsed	82-3/4"	86½"	83"	86"	83"	90"
5. Height, mast extended	199-3/4"	204-¼"	200½"	198-3/4"	208-3/4"	170"
6. Lifting height	181-3/4"	181-3/4"	180"	180-3/4"	189½"	144"
7. Free lift	24"	31-½"	23½"	25½"	12¼"	16"
8. Outside turn radius	78"	74"	80½"	80½"	78½"	77½"
9. Right angle stacking aisle by MIL-STD-268C	138"	134½"	143"	143½"	135½"	141"
10. By test, with 40"x 48" load	128"	120"	128"	128"	124"	128"
11. Weight, to laden	7860 lb	7656 lb	8638 lb	8588 lb	7851 lb	7595 lb
12. Weight on drive wheels	3120	3534	3888	3330	3576	3005
13. Weight on steer wheels	4740	4122	4750	5258	4275	4590
14. Stability, long, stacking	4%	4%	6%	6%	4%	4%
15. Stability, long, traveling	18%	19%	35%	28%	20%	18%
16. Stability lat., stacking	6%	6%	5½%	6%	8%	6%

Table III (Cont'd)

LIFT TRUCK COMPARISON CHART

17. Stability, lat., traveling	31%+	40%	40%	40%	40%	40%
18. Travel speed with load	9¼ mph	7.8 mph	10 mph	7.7 mph	8.3 mph	11.1 mph
19. Acceleration, with load	3.6 fps	3.3 fps	3.3 fps	2.8 fps	3.3 fps	4.9fps
20. Lifting speed, loaded	83 fpm	72 fpm	75 fpm	55 fpm	57 fpm	71 fpm
21. Lowering speed, loaded	60 fpm	82 fpm	94 fpm	64 fpm	71 fpm	85 fpm
22. Lowering speed, empty	53 fpm	54 fpm	78 fpm	62 fpm	68 fpm	55 fpm
23. Steering effort, first half	40 lb	20 lb	40 lb	30 lb	40 lb	25 lb
24. Steering effort, second half	46 lb	35 lb	60 lb	60 lb	80 lb	25 lb

NOTES: A. Trucks No. 2, 3, 4, and 5 are 180-inch, 4000-lb cap'y trucks previously tested. Truck No. 6 is a truck of 144" lift ht, 4000-lb cap'y, previously tested.

B. Items 1 through 17, 23 and 24 taken from Project Report MS0137-65S, Tobyhanna Army Depot, Tobyhanna, Penna., October 1965.

Table IV

OPERATOR PREFERENCE

CHARACTERISTICS	OPERATOR A		OPERATOR B		OPERATOR C		OPERATOR D		OPERATOR E		OPERATOR F	
	TEST TRUCK	STD TRUCK	TEST TRUCK	STD TRUCK	TEST TRUCK	STD TRUCK	TEST TRUCK	STD TRUCK	TEST TRUCK	STD TRUCK	TEST TRUCK	STD TRUCK
1. Propulsion-Speed-Acceleration-Gradeability	X		X		X		X		X		X	
2. Lifting and Lowering Speeds-Smoothness	X		X		X		X		X		EVEN	
3. Maneuverability-Steering and Handling	X			X	EVEN			X	X			X
4. Carloading and Unloading		X		X	No Experience		X		No Experience			X
5. Truck Loading and Unloading	X		X		No Experience		X		No Experience		X	
6. Stability	X		X		X		X		X		X	
7. Visibility		X		X		X		X		X		X
8. Inching	X		EVEN		X		X		X		EVEN	
9. Brake Performance		X		X	X			X	X			X
10. Quietness		X		X		X		X		X		X
11. All-around Performance	X		EVEN		EVEN		X		X			X

NOTES: a. Data taken from Project Report MSO 137-65S, Tobyhanna Army Depot, Tobyhanna, Penna, dtd October 1965.

b. Data of standard trucks represent operator opinion based on comparison with four standard trucks utilized during the test period, viz, Clark Models Clarklift 40 and Carloarder 4024, Yale Models KG51T40 and M-4J1.

Conclusions

(1) The Baker "Tiger Series" forklift truck is acceptable for general warehousing operations, particularly where increased storage heights are intended.

(2) The increased lifting speed, lowering speed, and acceleration can be used advantageously in normal warehousing operations.

(3) The Baker "Tiger Series" forklift truck is capable of increasing productivity in lift truck operation without sacrificing maneuverability, safety, or other operations important in lift truck operation.

Recommendations

This evaluation indicates that the following changes to Military Specification MIL-T-15445, Trucks, Lift, Fork, Gasoline, Solid Rubber Tires, should be made:

(1) Paragraph 3.6.1 Lifting Speed - Change the requirement from "not less than 40 feet per minute" to "not less than 60 feet per minute."

(2) Paragraph 3.6.2 Lowering Speed - Change the requirement from "not less than 27 feet per minute" to "not less than 40 feet per minute."

(3) Paragraph 3.6.19 Acceleration - Change "44 feet in not more than 6 seconds" to "44 feet in not more than 5.5 seconds, "and change "22 feet in not more than 4 seconds" to "22 feet in not more than 3.8 seconds."

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13 ABSTRACT

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